WRDC-TR-90-8007
Volume V
Part 13

INTEGRATED INFORMATION SUPPORT SYSTEM (IISS)
Volume V - Common Data Model Subsystem
Part 13 - Neutral Data Manipulation Language (NDML) Precompiler
Parse NDML Product Specification

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MANUFACTURING TECHNOLOGY DIRECTORATE
WRIGHT RESEARCH AND DEVELOPMENT CENTER
AIR FORCE SYSTEMS COMMAND
WRIGHT-PATTERSON AIR FORCE BASE, OHIO 45433-6533

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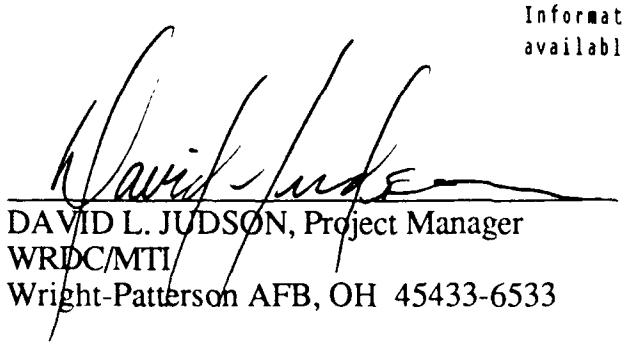

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DATE

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25 July 91
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This specification establishes the design of Function PRE3, "Parse NDML", one of the major functions of the Configuration Item "Precompiler" to be built and formally accepted by the ICAM Program Office.

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INTEGRATED INFORMATION SUPPORT SYSTEM
Vol V - Common Data Model Subsystem

Part 13 - Neutral Data Manipulation Language (NDML) Precompiler Parse NDML Product Specification

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FOREWORD

This technical report covers work performed under Air Force Contract F33600-87-C-0464, DAPro Project. This contract is sponsored by the Manufacturing Technology Directorate, Air Force Systems Command, Wright-Patterson Air Force Base, Ohio. It was administered under the technical direction of Mr. Bruce A. Rasmussen, Branch Chief, Integration Technology Division, Manufacturing Technology Directorate, through Mr. David L. Judson, Project Manager. The Prime Contractor was Integration Technology Services, Software Programs Division, of the Control Data Corporation, Dayton, Ohio, under the direction of Mr. W. A. Osborne. The DAPro Project Manager for Control Data Corporation was Mr. Jimmy P. Maxwell.

The DAPro project was created to continue the development, test, and demonstration of the Integrated Information Support System (IISS). The IISS technology work comprises enhancements to IISS software and the establishment and operation of IISS test bed hardware and communications for developers and users.

The following list names the Control Data Corporation subcontractors and their contributing activities:

SUBCONTRACTOR	ROLE
Control Data Corporation	Responsible for the overall Common Data Model design development and implementation, IISS integration and test, and technology transfer of IISS.
D. Appleton Company	Responsible for providing software information services for the Common Data Model and IDEF1X integration methodology.
ONTEK	Responsible for defining and testing a representative integrated system base in Artificial Intelligence techniques to establish fitness for use.
Simpact Corporation	Responsible for Communication development.
Structural Dynamics Research Corporation	Responsible for User Interfaces, Virtual Terminal Interface,and Network Transaction Manager design, development, implementation, and support.
Arizona State University	Responsible for test bed operations and support.

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SECTION 1

SCOPE

1.1 Identification

This specification establishes the design of Function PRE3, "Parse NDML", one of the major functions of the Configuration Item "Precompiler" to be built and formally accepted by the ICAM Program Office. This CPCI constitutes one of the subsystems of the Common Data Model Processor (CDMP).

1.2 Functional Summary

This function parses the NDML or SQL statements into tokenized form. Legal syntax is checked and syntax error messages issued.

SECTION 2

DOCUMENTS

2.1 Reference Documents

1. ICAM Documentation Standards: IDS15012000A, 28 December 1981.

2. D. Appleton Co., CDM Administrators Manual: UM620141000, March 1984.

3. D. Appleton Co., CDM1-IDEF1 Model of the Common Data Model; CCS620141000, 15 May 1985.

4. D. Appleton Co., Computer Program Development Specification (DS) for ICAM Integrated Support System (IISS) Configuration Item: NDML Precompiler; DS620141200, October 1984.

5. D. Appleton Co., Embedded NDML Programmer's Reference Manual; PRM620141200, March 1985.

6. Softech, Inc., NTM Programmer's Guide: UM620140001, July 1984.

7. Control Data Corporation, Computer Program Development Specification (DS) for ICAM Integrated Support System (IISS) Configuration Item: NDDL Command Processor; DS620141100, June 1985.

2.2 Terms and Abbreviations

Attribute Use Class: (AUC)

Conceptual Schema: (CS)

Common Data Model Processor: (CDMP)

Common Data Model: (CDM) Describes common data application process formats, form definitions, etc, of the IISS and includes conceptual schema, external, internal schemas, and schema transformation operators.

Data Field: (DF) An element of data in the external schema. It is by this name that an NDML programmer references data.

Database Management System: (DBMS)

Distributed Request Supervisor: (DRS) This IISS CDM subsystem configuration item controls the execution of distributed NDML queries and non distributed updates.

Domain: A logical definition of legal attribute class values.

Domain Constraint: Predicate that applies to a single domain.

External Schema: (ES)

Forms: Structured views which may be imposed on windows or other forms. A form is composed of fields where each field is a form, item, or window.

Forms Processor: (FP) A set of callable execution time routines available to an application program for form processing.

Internal Schema: (IS)

Integrated Information Support System: (IISS) A test computing environment used to investigate, demonstrate and test the concepts of information management and information integration in the context of Aerospace Manufacturing. The IISS addresses the problems of integration of data resident on heterogeneous databases supported by heterogeneous computers interconnected via a local Area Network.

Mapping: The correspondence of independent objects in two schemas: ES to CS or CS to IS.

Network Transaction Manager: (NTM) Performs the coordination, communication and housekeeping functions required to integrate the application processes and system services resident on the various hosts into a cohesive system.

Neutral Data Manipulation Language: (NDML) A language developed by the IISS project to provide uniform access to common data, regardless of database manager or distribution criteria. It provides distributed retrieved and single node updates.

ORACLE: Relational DBMS based on the SQL (Structured Query Language, a product of ORACLE Corp, Menlo Park, CA). The CDM is an ORACLE database.

Parcel: A sequential file containing sections source code of the input application program.

Request Processor: (RP) A COBOL program that will satisfy a retrieval or update NDML subtransaction against a particular Database Management System.

User Interface: (UI) Controls the user's terminal and interfaces with the rest of the system.

Virtual Terminal Interface: (VTI) Performs the interfacing between different terminals and the UI. This is done by defining a specific set of terminal features and protocols which must be supported by UI software which constitutes the Virtual Terminal Definition. Specific terminals are then mapped against the Virtual Terminal software by specific software modules written for each type of real terminal supported.

SECTION 3

REQUIREMENTS

3.1 Structural Description

A graphic portrayal of this Computer Program Configuration Item (CPCI) is included in Section 3.10. This chart shows the hierarchical relationship of each module making up this CPCI. This module is accessed for each NDML or SQL command identified by PRE2. The routine is generated by the UNIX tools YACC and LEX. YACC generates a parser given the syntax rules as input. LEX generates the lexical analyzer for the language given the definitions of the lexical units of the language. The parser generated by YACC is named YYPARSE and the lexical analyzer is named YYLEX. PRE2 controls the call to YYPARSE. Whenever YYPARSE (the parser) needs another token or unit of command input, YYLEX is called. Whenever YYLEX needs another character of the user command, YYINPUT is called. In this application, YYINPUT has been modified to record the next character from the file containing NDML or SQL commands. The parsed tokens are stored in global data structures accessible by "C" primitives. PRE2 then uses these primitives to access the "C" data structures, storing them in COBOL tables and checking command semantics.

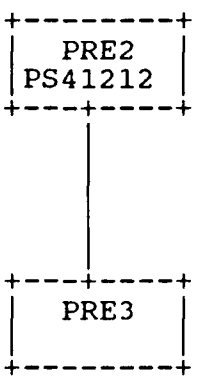
3.2 Functional Flow

This CPCI implements the logic defined in the Development Specification for this CPCI. Details of inputs/outputs and relationships between modules are to be found in Section 3.10.

This CPCI has been designated to operate in a batch or interactive mode. It must use the ORACLE DBMS installed on a DEC VAX computer.

3.3 Interfaces

The following diagram depicts the interface of PRE3 with other CPCI's in the system.



3.3.1 Inputs/Outputs

The following table depicts the inputs and outputs of this CPCI. A detailed description for each item can be found in the DS for this CPCI.

FUNCTION: PRE3

INPUT	OUTPUT
Input File Pointer	Command Number
Parcel 4 File Pointer	Module Status
Error File Pointer	

3.4 Program Interrupts

Not applicable to this CPCI.

3.5 Timing and Sequencing Description

PRE3 is called once for every NDML or SQL statement encountered in the user's input program.

3.6 Special Control Features

Not applicable to this CPCI.

3.7 Storage Allocation

3.7.1 Database Definition

No databases are used by this CPCI.

3.7.1.1 File Description

No permanent files have been defined for this CPCI. It may use temporary scratch files for such things as generated program source code or temporary query results.

3.7.1.2 Table Description

All tables used by this CPCI have been defined by the Development Specification for this CPCI.

3.7.1.3 Item Description

Not applicable to this CPCI.

3.8 Object Code Creation

The object code for this CPCI will be created by the system integration test team by using defined IISS Software Configuration Management procedures. This CPCI will use the COBOL and "C" language compilers. In addition, source code generated by the YACC and LEX tools must be compiled to become objects in the final, executable software package.

3.9 Adaptation Data

This CPCI has been coded using ANSI COBOL and a "standard" subset of the "C" languages. The intent was to provide a transportable system. Any system environment supporting these languages, a virtual memory management scheme, and the ORACLE Database Management System should be able to support this CPCI. Every possible attempt has been made to localize and identify any machine or environment dependent modules through the original design of the IISS and application of Configuration Management Procedures.

3.10 Detail Design Description

The following sections have been computer generated for this CPCI.

3.10.1 Where Include File Used List

The following lists each include file in the documentation group and all the modules documented in this specification which include them. The purpose of each module is listed as well.

DOCGROUP PS41213 Where-include-file-used List

Include File	Module Name
CHKCDM	
	CDTRANS
ERRCDM	
	CDTRANS
ESQUAL	
	CDTRANS
BOOLST	
	CDTRANS
ERRPRO	
	CDTRANS
STDIO	
	LINFIL
	NDMLPAR
	UNSUPPORTED
	YYERROR
	YYPARSE
	YYWRAP
CSTDTYP	
	NDMLPAR
FCBSTRC	
	NDMLPAR
NDMLYAC.INP"	
	LINFIL
	UNSUPPORTED
	YYERROR
	YYPARSE
	YYWRAP

ATTRID
LINFIL
UNSUPPORTED
YYERROR

DOCGROUP PS41213 Where-include-file-used List

Include File	Module Name
	YYPARSE
	YYWRAP
CMDID	
	LINFIL
	UNSUPPORTED
	YYERROR
	YYPARSE
	YYWRAP
LISTID	
	LINFIL
	UNSUPPORTED
	YYERROR
	YYPARSE
	YYWRAP
NDMLSTB	
	LINFIL
	UNSUPPORTED
	YYERROR
	YYPARSE
	YYWRAP
NDMLEXY	
	LINFIL
	UNSUPPORTED
	YYERROR
	YYPARSE
	YYWRAP

3.10.2 Where External Routine Used List

The following lists each external function or routine in the documentation group and all the documented modules which call it. The purpose of each module is listed as well.

DOCGROUP PS41213 Where-external-routine-used List

System Module	Module Name
ERRPRO	
	CDTRANS
NDMLPAS	
	NDMLPAR
YYINPUT	
	NDMLPAR
PUTC	
	NDMLPAR
GETC	
	LINFIL
FPUTC	
	LINFIL
FPRINTF	
	LINFIL
UNGETC	
	LINFIL
INPUT	
	UNSUPPORTED
	YYERROR
OUTPUT	
	UNSUPPORTED
	YYERROR
SPRINTF	
	UNSUPPORTED
	YYERROR
STRLEN	
	UNSUPPORTED
	YYERROR
WRITERR	
	UNSUPPORTED
	YYERROR

DOCGROUP PS41213 Where-external-routine-used List

System Module	Module Name
FREE_SYMTAB	
	UNSUPPORTED
	YYERROR
PRINTF	
	YYPARSE
MEMCPY	
	YYPARSE
NEW_SCOPE	
	YYPARSE
EXIT_SCOPE	
	YYPARSE
CHAIN_SYMB	
	YYPARSE
PUT_SYMB	
	YYPARSE
STRNCPY	
	YYPARSE
STRCPY	
	YYPARSE
YYLEX	
	YYPARSE

3.10.3 Main Program Parts List

The following lists each Main Program in the documentation group and all the modules which are called either by that module itself or by any of the documented modules which it calls. It is possible for a non-main module to be listed more that once if it is called by multiple modules. The called modules, in this case known as program parts, are marked as to whether they are documented here. If so, the phrase "well-defined module" appears by the module name, if not it is an "external "routine". The Purpose of the Main Program module is listed as well.

DOCGROUP PS41213 Main Program Parts List

Main Pgm Name	Module Name	Module Type
CDTRANS		
	ERRPRO	External routine
LINFIL		
	GETC	External routine
	FPUTC	External routine
	FPRINTF	External routine
	UNGETC	External routine
NDMLPAR		
	NDMLPAS	External routine
	YYINPUT	External routine
	PUTC	External routine
UNSUPPORTED		
	INPUT	External routine
	OUTPUT	External routine
	SPRINTF	External routine
	STRLEN	External routine
	WRITERR	External routine
	FREE_SYMTAB	External routine
YYERROR		
	INPUT	External routine
	OUTPUT	External routine
	SPRINTF	External routine
	STRLEN	External routine
	WRITERR	External routine
	FREE_SYMTAB	External routine
YYPARSE		
	PRINTF	External routine
	YYERROR	External routine
	MEMCPY	External routine
	NEW_SCOPE	External routine
	EXIT_SCOPE	External routine

DOCGROUP PS41213 Main Program Parts List

Main Pgm Name	Module Name	Module Type
	LINFIL	External routine
	CHAIN_SYMB	External routine
	PUT_SYMB	External routine
	STRNCPY	External routine
	STRCPY	External routine
	UNSUPPORTED	External routine
	YYLEX	External routine
YYWRAP		

3.10.4 Module Documentation

The following documentation describes information which is specific to each individual module in the documentation group being documented in this specification. It provides a compact way of getting information that would be otherwise buried within each module's source code.

The specific items in this module documentation have the following meanings:

NAME: Name of program Module.

PURPOSE: Purpose of Module as detailed in the source code.

LANGUAGE: Programming language source code is written in.
The choices are:
VAX-11 FORTRAN
C (I/S-1 Workbench 'C')
VAX-11 COBOL

MODULE TYPE: Whether a Program, Subroutine, or Function.

SOURCE FILE: Name of Source File from file specification.

SOURCE FILE TYPE: Source File Extension from file specification.

HOST: Whether this is a host-dependent routine (VAX or IBM) or blank if host-independent.

SUBSYSTEM: IISS sub-system this file resides in.

SUBDIRECTORY:	Sub-directory of that subsystem in which this file resides.
DOCUMENTATION GROUP:	Name of documentation group of which this source file is a member.
DESCRIPTION:	A description of the module as otained from the source code.
ARGUMENTS:	The arguments with which this routine is called if it is a Subroutine or a Function.
INCLUDE FILES:	A list of all the files that are included into this module as well as their purposes.
ROUTINES CALLED:	Subroutines or Functions, either documented or external, called by this module, if any.
CALLED DIRECTLY BY:	The documented routines which call this module, if any.
USED IN MAIN PROGRAM(S):	The documented Main Programs which contain this module in their parts list according to the list in section 3.10.3.

The Module Documentation is arranged alphabetically according to Module Name.

DOCGROUP PS41213 Module Documentation

NAME: CDTRANS
PURPOSE: TRANSLATE EXCLUSIVE OR (XOR) AND NOT OPERATORS.
LANGUAGE: VAX-11 COBOL
SOURCE FILE: CDTRANS
SOURCE FILE TYPE: COB
HOST:
SUBSYSTEM: CDM
SUBDIRECTORY: NDML

DESCRIPTION:

- THIS FUNCTION WILL TRANSLATE THE "XOR" AND "NOT" OPERATORS IN THE WHERE CLAUSE OF THE NDML STATEMENT. IT WILL UPDATE BOTH THE ES-QUALIFY-LIST AND BOOLEAN-LIST TO REFLECT THE TRANSLATION OF "XOR" AND "NOT" TO ALL "AND" AND "OR" OPERATORS.

-

ARGUMENTS:

ES-QUALIFY-LIST	RECRD
BOOLEAN-LIST	RECRD
RET-STATUS	DSPLY[X(5)]

INCLUDE FILES:

CHKCDM
ERRCDM
ESQUAL
BOOLST
ERRPRO

ROUTINES CALLED:

ERRPRO

ARGUMENTS:

FCB_IN	FCB **
FCB_ERROR	FCB **
FCB_4	FCB **
COM_NO	INT *
STATUS	INT *

INCLUDE FILES:

STDIO
CSTDTYP
FCBSTRC

ROUTINES CALLED:

NDMLPAS
YYINPUT
PUTC

DOCGROUP PS41213 Module Documentation

NAME: YYWRAP
PURPOSE:
LANGUAGE: C
SOURCE FILE: NDMLYTB
SOURCE FILE TYPE: C
HOST:
SUBSYSTEM: CDM
SUBDIRECTORY: NDML

INCLUDE FILES:

NDMLYAC.INP"
STDIO
ATTRID
CMDID
LISTID
NDMLSTB
NDMLEXY

DOCGROUP PS41213 Module Documentation

NAME: LINFIL
PURPOSE:
LANGUAGE: C
SOURCE FILE: NDMLYTB
SOURCE FILE TYPE: C
HOST:
SUBSYSTEM: CDM
SUBDIRECTORY: NDML

INCLUDE FILES:

NDMLYAC.INP"
STDIO
ATTRID
CMDID
LISTID
NDMLSTB
NDMLEXY

ROUTINES CALLED:

GETC
FPUTC
FPRINTF
UNGETC

DOCGROUP PS41213 Module Documentation

NAME: YYERROR
PURPOSE:
LANGUAGE: C
SOURCE FILE: NDMLYTB
SOURCE FILE TYPE: C
HOST:
SUBSYSTEM: CDM
SUBDIRECTORY: NDML

ARGUMENTS:

S CHAR *

INCLUDE FILES:

NDMLYAC.INP"
STDIO
ATTRID
CMDID
LISTID
NDMLSTB
NDMLEXY

ROUTINES CALLED:

INPUT
OUTPUT
SPRINTF
STRLEN
WRITERR
FREE_SYMTAB

DOCGROUP PS41213 Module Documentation

NAME: UNSUPPORTED
PURPOSE:
LANGUAGE: C
SOURCE FILE: NDMLYTB
SOURCE FILE TYPE: C
HOST:
SUBSYSTEM: CDM
SUBDIRECTORY: NDML

ARGUMENTS:

S CHAR *

INCLUDE FILES:

NDMLYAC.INP"
STDIO
ATTRID
CMDID
LISTID
NDMLSTB
NDMLEXY

ROUTINES CALLED:

SPRINTF
STRLEN
WRITERR
INPUT
OUTPUT
FREE_SYMTAB

DOCGROUP PS41213 Module Documentation

NAME: YYPARSE
PURPOSE:
LANGUAGE: C
SOURCE FILE: NDMLYTB
SOURCE FILE TYPE: C
HOST:
SUBSYSTEM: CDM
SUBDIRECTORY: NDML

INCLUDE FILES:

NDMLYAC.INP"
STDIO
ATTRID
CMDID
LISTID
NDMLSTB
NDMLEXY

ROUTINES CALLED:

PRINTF
YYERROR
MEMCPY
NEW_SCOPE
EXIT_SCOPE
LINFIL
CHAIN_SYMB
PUT_SYMB
STRNCPY
STRCPY
UNSUPPORTED
YYLEX

3.10.5 Include File Descriptions

The following list contains a purpose and description of each include file in the documentation group as specified in the source code. The language it is written in is also given.

DOCGROUP PS41213 Include File Description

FILE NAME: BOOLST
PURPOSE: BOOLEAN LIST
LANGUAGE: VAX-11 COBOL

DESCRIPTION:

CONTAINS THE BOOLEAN OPERATORS, PARENTHESES, AND POINTERS TO THE TYPE 2 CONDITIONS FOR AN NDML TRANSACTION

DOCGROUP PS41213 Include File Description

FILE NAME: CHKCDM
PURPOSE: IISS CDMP CHECK STATUS CODES
LANGUAGE: VAX-11 COBOL

DESCRIPTION:

CONTAINS ALL STATUS CODES FOR THE CDMP MODULES *

DOCGROUP PS41213 Include File Description

FILE NAME: ERRCDM
PURPOSE: IISS ERROR STATUS CODES FOR CDMP MODULES
LANGUAGE: VAX-11 COBOL

DESCRIPTION:

CONTAINS ALL ERROR CODES USED BY CDMP MODULES FOR ERROR HANDLING *

DOCGROUP PS41213 Include File Description

FILE NAME: ERRPRO
PURPOSE: PROCESS ERROR INCLUDE FILE
LANGUAGE: VAX-11 COBOL

DESCRIPTION:

DOCGROUP PS41213 Include File Description

FILE NAME: ESQUAL
PURPOSE: EXTERNAL SCHEMA QUALIFY LIST
LANGUAGE: VAX-11 COBOL

DESCRIPTION:

CONTAINS EXTERNAL SCHEMA INFORMATION FOR THE NDML QUALIFICATION

THE EXTERNAL SCHEMA QUALIFY LIST

DOCGROUP PS41213 Include File Description

FILE NAME: LISTID
PURPOSE: PROVIDES LIST OF PARSED OBJECTS
LANGUAGE: C

DESCRIPTION:

DESCRIPTION

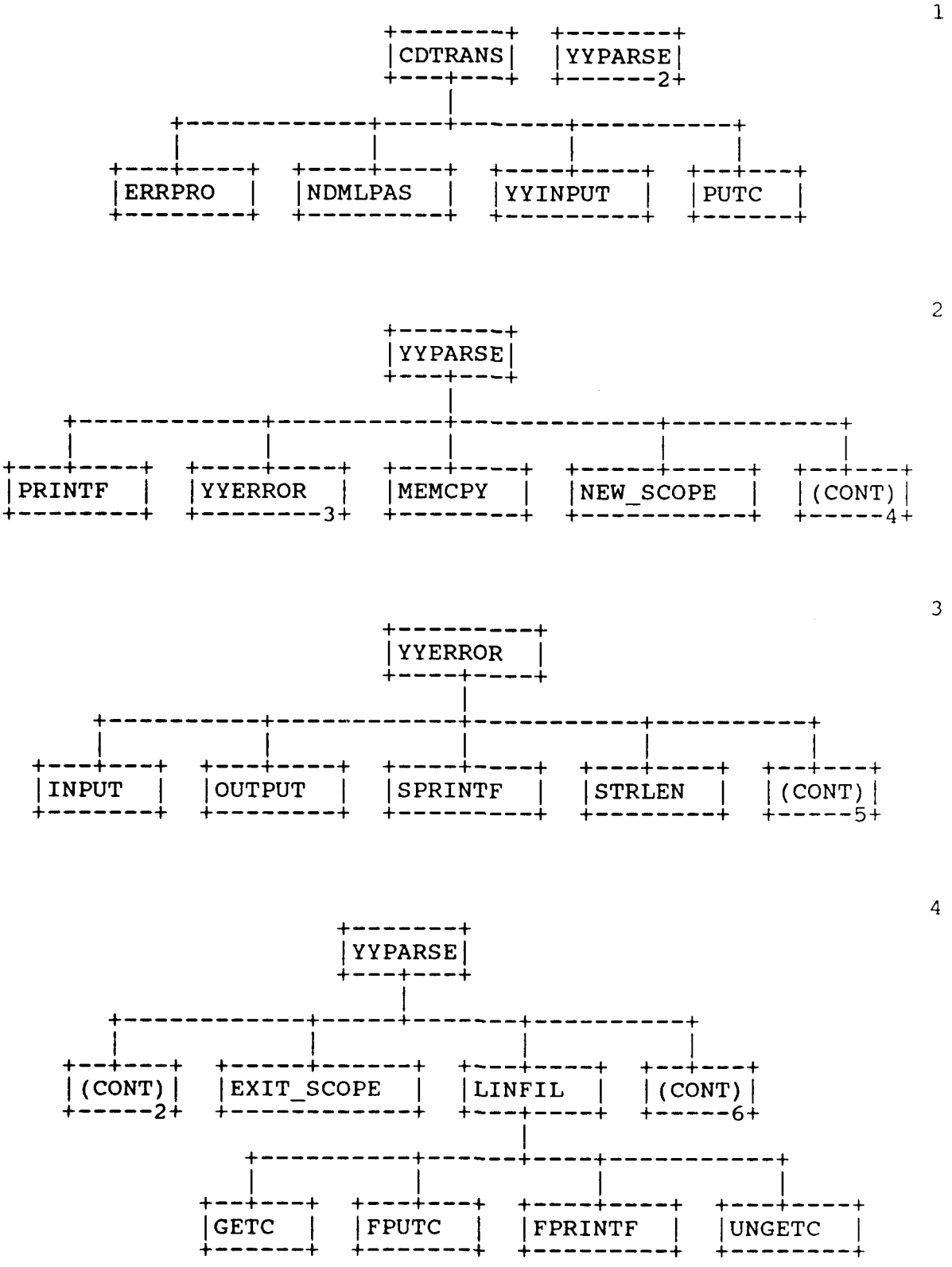
DOCGROUP PS41213 Include File Description

FILE NAME: NDMLEXY
PURPOSE: LEX GENERATED INCLUDE FILE
LANGUAGE: C

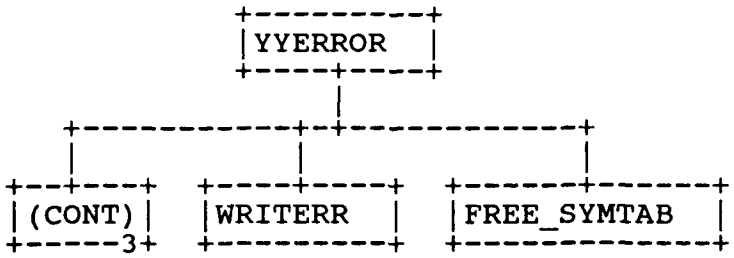
DESCRIPTION:

DESCRIPTION

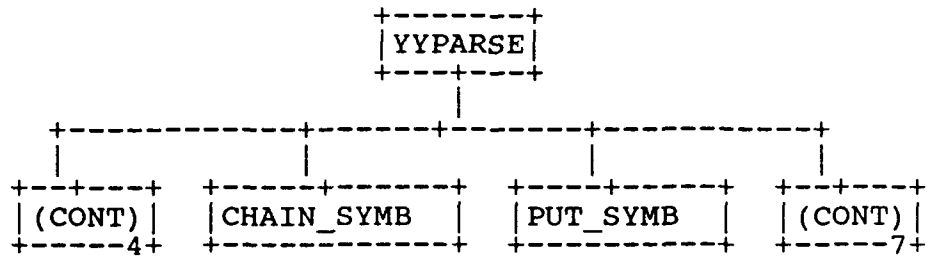
3.10.6 Hierarchy Chart



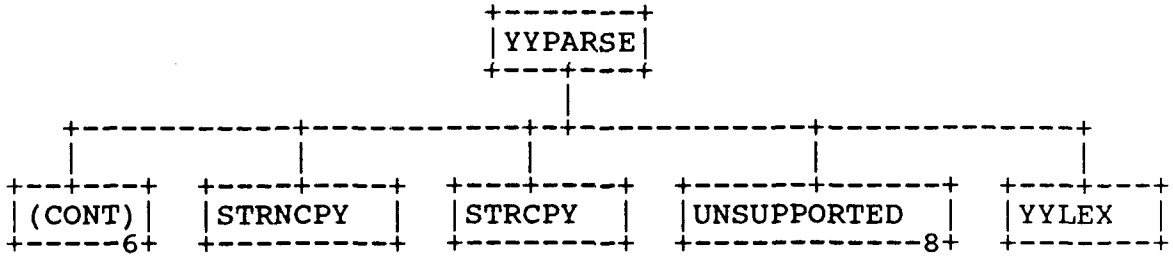
5


YYERROR
(CONT)
3
WRITERR
FREE_SYMTAB

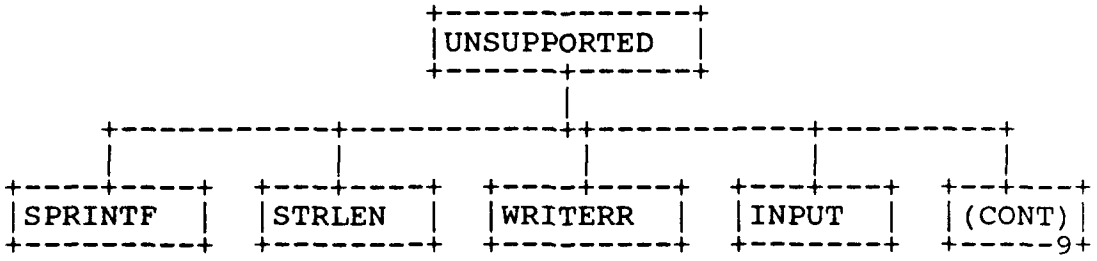
6


YYPARSE
(CONT)
4
CHAIN_SYMB
PUT_SYMB
(CONT)
7

7


YYPARSE
(CONT)
6
STRNCPY
STRCPY
UNSUPPORTED
8
YYLEX

8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SPRINTF
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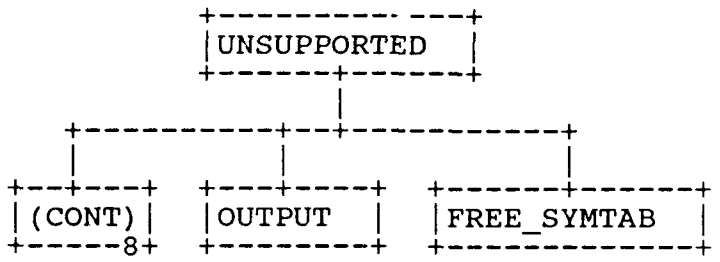

CDTRANS.....1
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ERRPRO
EXIT_SCOPE
FPRINTF
FPUTC
FREE_SYMTAB
GETC
INPUT
LINFIL 4
MEMCPY
NDMLPAS
NEW_SCOPE
OUTPUT
PRINTF
PUTC
PUT_SYMB
SPRINTF
STRCPY
STRLEN
STRNCPY
UNGETC
UNSUPPORTED 8
WRITERR
YYERROR 3
YYINPUT
YYLEX
YYPARSE.....2

3.11 Program Listings Comments

This information is contained in the Module Descriptions in section 3.10.

SECTION 4

QUALITY ASSURANCE PROVISIONS

4.1 Introduction and Definitions

"Testing" is a systematic process that may be preplanned and explicitly stated. Test techniques and procedures may be defined in advance, and a sequence of test steps may be specified. "Debugging" is the process of isolation and correction of the cause of an error.

"Antibugging" is defined as the philosophy of writing programs in such a way as to make bugs less likely to occur and when they do occur, to make them more noticeable to the programmer and the user. In other words, as much error checking as is practical and possible in each routine should be performed.

4.2 Computer Programming Test and Evaluation

The quality assurance provisions for test consists of the normal testing techniques that are accomplished during the construction process. They consist of design and code walk-throughs, unit testing, and integration testing. These tests are performed by the design team. Structured design, design walk-through and the incorporation of "antibugging" facilitate this testing by exposing and addressing problem areas before they become coded "bugs."

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